Alternative FUELS IN TRUCKING

Volume 5, Number 3

Natural Gas Vehicles: Wave of the Future

by Congressman Joe Barton

Almost 50% of the petroleum consumed in the United States is imported. By the year 2000, 73% of total petroleum demand will be imported, making America vulnerable to a cutoff in our energy lifeline. Transportation, which is 98% dependent on petroleum, uses two-thirds of the oil consumed in the United States. If we instead used American-produced natural gas to power our vehicles, we could become energy independent.

Natural gas could also solve some of our toughest environmental problems. Gasoline- and diesel-fueled cars, trucks, and buses produce half of all air pollution in the United States. Natural gas would cut emissions to zero.

Congress has recognized the opportunity and enacted legislation to provide incentives for or mandate the production of alternative fuel vehicles (AFVs).

In 1988, Congress imposed Corporate Average Fuel Economy standards for vehicles and imposed significant fines on those who fail to meet them. In 1990, the Clean Air Act Amendments tightened emission controls on a variety of air pollutants, and created a clean fuels fleet program. In 1992, the Energy Policy Act (EPAct) was passed to respond to the energy security concerns raised by the Gulf War. It contains several mandates and incentives to increase the use of AFVs.

But we have just scratched the surface of the use of natural gas vehicles (NGVs). There is still much more to be done. That is why Speaker Gingrich created the Congressional Task Force on Natural Gas Vehicles and appointed me chairman.

We found that there are more than 1,100 natural gas fueling stations in the United States and nearly 50,000 NGVs on the road in the United States today. That number could dramatically increase, particularly if more trucks are fueled by natural gas.

The natural gas option is so good because it is potentially cheaper than gasoline. At today's prices, natural gas is approximately one-third as expensive as regular unleaded gasoline and and one-half the price of diesel.

Manufacturers are stepping up to meet the demand. In the 1996 model year, a number of factory-built NGVs became available from Detroit.

This opportunity demands a serious response by Congress. Prior legislation has tried to increase general awareness of and created a limited fleet market for NGVs. But current law and regulations have not provided the impetus for their mass production, which is the reason I am trying to redirect the role of the federal government. We now understand the barriers to incentives for using natural gas. To remove those barriers we have formulated the Natural Gas Vehicle Incentives Act of 1996.

First, this legislation will establish an emission reduction credit program for NGVs and a fueling infrastructure. Next, it will establish a tax credit for NGVs and fueling stations used for business purposes (specifically targeting fleet operators). In addition, the bill provides shorter depreciation recovery periods for

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NGVs and refueling property. Pending the enactment of these incentives, our legislation proposes to eliminate the private fleet mandates imposed by EPAct and will in 1999 sunset the state fleet mandates and fuel provider mandates contained in EPAct.

The bill also corrects the tax rate for liquefied natural gas (LNG), the clean fuel alternative to diesel. Because LNG is a liquid form of compressed natural gas, it provides increased storage needed for long hauls. However, until the tax rate is corrected, the market for LNG will cease to exist except in tax-exempt public fleets.

This legislation help decrease the transportation sector's dependence on imported oil, enhance our air quality, increase domestic economic activity, and minimize the cost to taxpayers. Incentives to the private sector are the most efficient and effective means to produce long-term reductions in motor vehicle emissions and oil imports.

We have witnessed staggering technological advancements during the past 100 years. The changes in the next 100 years will be even more dramatic, and I believe a dramatic increase in natural gas-powered cars and trucks will be one of those changes.

Heavy-Duty Truck Project in the Spotlight

Airgas Houston-Penske Truck Leasing

Airgas, Inc., is a premier distributor of industrial, medical, and specialty gases in North America. Its operations include a vast network of more than 500 distribution locations throughout the continent. Because of the company's daily involvement with these products, it investigated the use of natural gas as an alternative fuel for its fleet. As is always the case with moving to a different technology, Airgas conducted research to decide which of the several alternative fuels best suited their needs, and which location would prove the most advantageous. Inquiries led Airgas to choose liquefied natural gas (LNG) as the fuel, and Houston as the location, because that city has the beginnings of an LNG infrastructure. Airgas also wanted to ensure that its involvement with LNG was conducted so as to maximize its learning experience without losing productivity. To achieve this, Airgas turned to Penske Truck Leasing, one of the nation's major full service truck leasing companies, whose services would include full maintenance and repair for the LNG-powered trucks.

Penske's servicing of the LNG-powered trucks would yield valuable data on their operations in day-to-day revenue service, and could be easily matched for control purposes with identical conventionally powered trucks in nearly identical service. Such a project appealed to the Trucking Research Institute, which has been engaged for several years with DOE's National Renewable Energy Laboratory (NREL) in facilitating heavy-duty truck alternative fuel projects in revenue service. As a result, NREL agreed to sponsor the project, in return for receiving data from the operations of the trucks.

Particularly appealing was the fact that these straight trucks were the first produced “on line” by Freightliner. Detroit Diesel's S50G engine powers the trucks, for which the chassis chosen was Freightliner's FLD-112. Two LNG-powered trucks were produced, and delivered along with a new diesel-powered vehicle to serve as a control for the project. The fuel storage and delivery system produced by Minnesota Valley Engineering was installed at Freightliner as part of the original equipment manufacturer (OEM) production process. That system consists of two, 90-gallon tanks, which provide adequate capacity for the trucks as they deliver industrial gases in greater Houston. The routes require the trucks to make 15 to 20 stops per day, and each vehicle logs about 40,000 miles each year. Each day's run is about refueling takes place weekly, and is done at one of the LNG fueling facilities operated by the Houston Metro, whose fuel is 99.5% pure methane supplied by Praxair's LNG plant at Willis, Texas.

Since the trucks entered service in May 1996, there have been relatively few growing pains. Drivers have expressed pleasure at the quiet and smooth ride with their spark-ignited, 300- horsepower engines. They also state that the trucks are clean, and produce far lower levels of fumes during the stop-and-start driving conditions that characterize their routes.

The Learning Curve in LNG Alternative Fuel Trucks

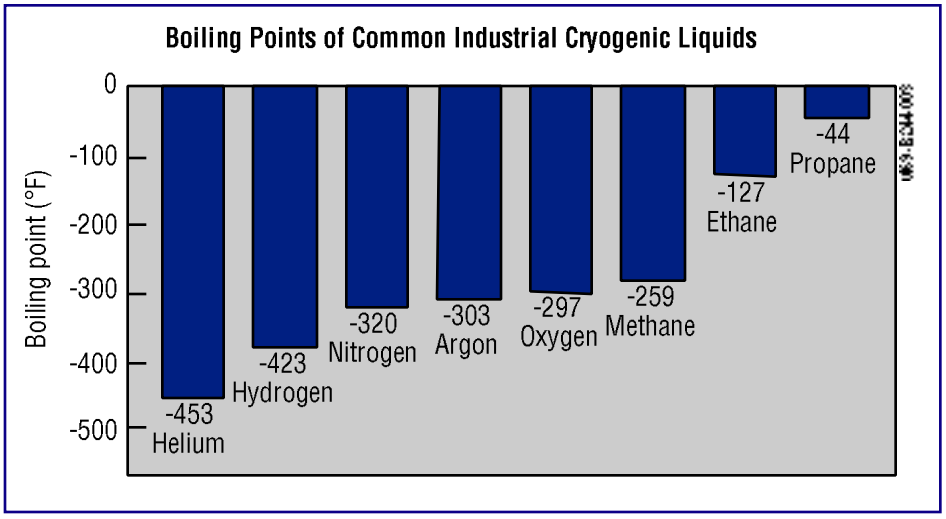
by Bill Peerenboom, Vice President, Trucking Research Institute

Creating an alternatively fueled commercial truck means finding a fuel and engine that can compete with the most efficient fuel and engine system on earth, the diesel. We are discussing commercial vehicles, so the competition must be on all fronts: economics, performance, reliability, availability and, of course, safety. Once each of these competitive factors comes into play, it brings with it a whole series of issues. The simplest, but certainly not the only, economic factor is base cost of the fuel itself, measured not only on a volume basis, but also on a cost per unit of energy, or distance. In the case of LNG, there really is competitiveness with diesel at the level of raw product cost, but one must be sure to define the product. There are various kinds of LNG; the most plentiful, called "peak shaving," is reasonably available and cost competitive. There is, however, the issue of whether that kind of LNG is suitable to power a truck, as opposed to fuel a furnace. Because LNG is a cryogenic version of natural gas—a chemical mixture as opposed to a chemical compound—any given sample can, and usually does, vary in its chemical makeup. Therefore, cost competitiveness must be tempered with recognition of the particular LNG quality, expressed as some sort of specification.

The designers and builders of an engine need to decide which fuel will best suit the needs of that engine. After all, if the fuel doesn't work, for whatever the reason, the engine manufacturer will get the call. So, for simplicity, we will use the convention LNG*, understanding that (1) the star (*) implies the LNG discussed meets the quality and content standards of engine manufacturers; and (2) because of differences in design, there may be some minor differences in the specification.

Because of the cryogenic nature of LNG (starred or not), its composition is always changing to some degree, because it is always "boiling." While it boils, the individual components (methane, ethane, propane, nitrogen, etc.) leave the liquid state and becoming vapor one at a time, each as it reaches its own boiling point. Over time, the fuel undergoes some chemical change—it "weathers." The rate at which weathering occurs is a function of many things, among them tank configuration (size, shape, and construction), and rate of use. LNG* aboard a vehicle being driven is being burned, and it meets engine specifications, so the weathering effect is not an issue.

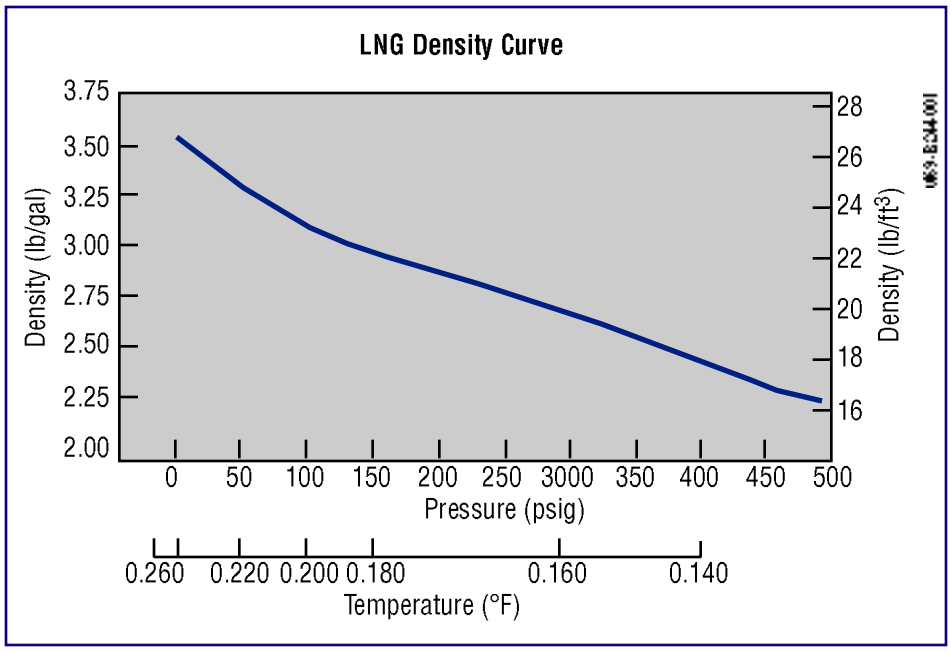
More importantly, users of conventionally fueled trucks are not accustomed to worrying about what they buy, so with alternative fuels, the same condition must apply. LNG* has to be composed of whatever component percentages engine manufacturers specify. These manufacturers have learned the effects of greater or lesser concentrations of methane, and of the several other elements and compounds that constitute "impurities." The user must understand and be aware of the manufacturer's specification be satisfied that the fuel supply meets the specification; in other words, "trust but verify."



The next differences that users of commercially operated LNG* trucks

must understand relate to fuel storage and delivery. LNG's* competitive advantage as a transportation fuel is, in part, due to its reasonably comparable energy density, which gives an LNG* truck competitive, although not equal, range to its diesel counterpart. Fortunately, truck fuel tanks are generally of simple geometric shapes, and numbers of similarly shaped cryogenic tanks are manufactured for other uses. These can readily be fitted to a tractor chassis with little or no difficulty. These tanks, however, are far more complex than their diesel counterparts; they are actually very sophisticated "thermos bottles." Additionally, because the engine burns the fuel as a vapor, and the tank stores it as a liquid, the fueling system itself is more complex than its diesel competitor, because the system must be able to convert the liquid to a vapor and deliver it to the engine at a specific pressure. In most trucks, this is done without benefit of a pump; the system is designed to rely on the application of differential pressures and temperatures through the use of regulators, heat exchangers, and valves. The necessary design and component configurations are arrived and through the concentrated cooperative efforts of truck chassis OEMs, engine manufacturers, and fuel tank suppliers.

Once the engine-fuel system design physics are determined, the truck has acquired a characteristic not shared by the diesel truck—it must be "compatible" with the capabilities that refueling sites must meet. Each refueling site must be able to deliver LNG* at a particular pressure and temperature to vehicles being fueled.



Pressure and temperature? Yes, because LNG, like all cryogenic fluids, changes density (mass per unit volume) as a function of both, and for each pressure there is a particular temperature at which the fluid is most heavily concentrated when the fluid is said to be "saturated," or "conditioned."

Why should the operator care about such an esoteric concept? Simply because a gallon of saturated fuel contains more energy than a gallon of unsaturated fuel, and inattention to this fact can cause the operation to literally run out of gas. So the operator needs to know that his fuel supplier is providing and dispensing saturated or conditioned LNG*, or there could be trouble.

Fuel storage—either on-board or for dispensing—must also account for the fact that over time, LNG* in a tank boils; because the tank is a closed-pressure vessel, its pressure will rise. The remedy is to use the fuel—either send it to the engine, or dispense it to a vehicle. The operative caveat is "use it or lose it," because each tank has a relief valve that will lift when the tank pressure increases to its set point. This is called "venting," and is critical to the economics of LNG* because fuel that vents is money lost.

Finally, in addition to these economic and physical challenges, building and operating LNG*-powered trucks must be done safely and legally. That means designs, construction, operation, and maintenance must be consistent with the unique safety requirements that relate to LNG*, and that trucks must comply with federal, state, and local laws, regulations, and industry practices set down for them.

All these complications may seem like serious barriers to competition. They are, but the good news is that the necessary steps to break them down have been, or are being, taken.

Christine Ervin Speaks at Natural Gas Vehicle Conference

Extracts from the Remarks of Christine Ervin, Assisstant Secretary of Energy Efficiency and Renewable Energy, Keynote Speech to the 14th National Natural Gas Vehicle Conference, Dallas, Texas, September 17, 1996

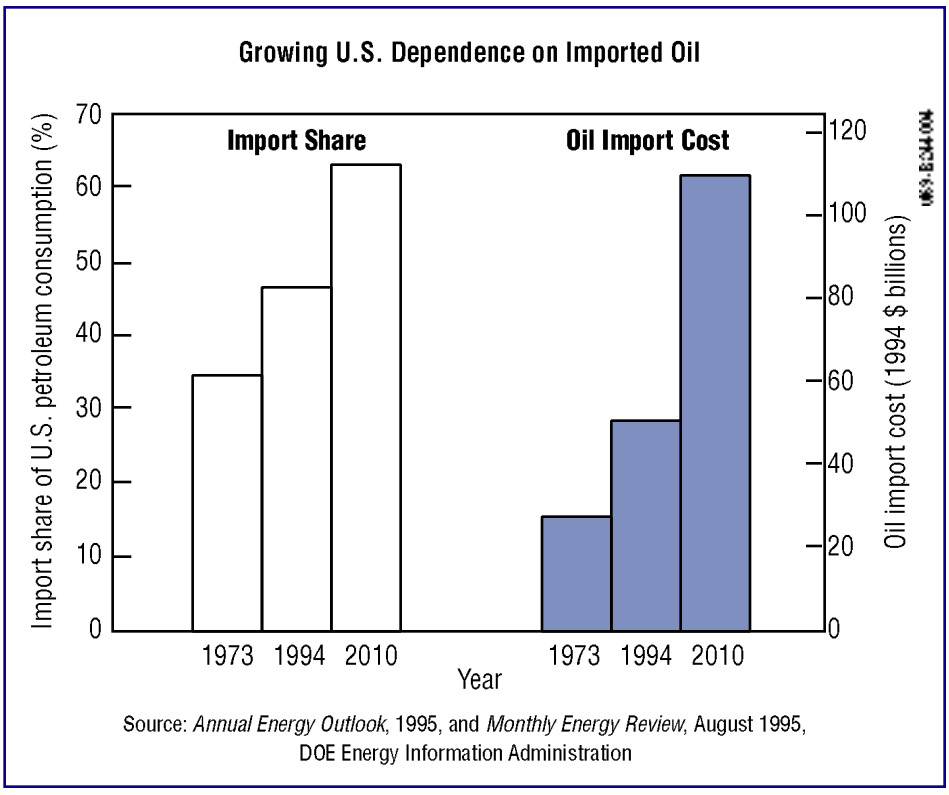
Many of you have seen the cover story in last April's issue of *Atlantic Monthly*, written by my principal deputy, Joe Romm, and deputy secretary Charles Curtis. It starts by asking us to ". . . imagine a world in which the Persian Gulf controlled two-thirds of the world's oil for export with $200 billion a year in oil revenues streaming into that unstable and politically troubled region, and America importing nearly 60 percent of its oil, resulting in a $100 billion year outflow that undermined efforts to reduce our trade deficit."

That's a scenario out of the 1970s which can never happen again, right? No, that's the base case for 10 years from now from the independent Energy Information Administration.

Now, as tensions continue in the Persian Gulf, we see articles like the one in last weekend's Washington Post headline: "If we kicked the oil habit, Saddam wouldn't menace us."

This concern about oil dependency is shared by experts from every point on the political spectrum. Don Hodel, Secretary of Energy under Ronald Reagan, said that we are "sleepwalking into a disaster," and predicts a major oil crisis within the next decade. Irwin Stelzer, of the American Enterprise Institute, says that the next oil shock "will make those of the 1970s seem trivial by comparison." Robert Dole said in a speech last year that "the second inescapable reality of the post-20th century world is that the security of the world's oil and gas supplies will remain a vital national interest of the United States and of other industrial powers."

Clearly, our ever-growing dependence on imported oil, now at a record high, is a major problem looking for a solution. An important part of that solution is the development of a market for alternative fuels and more efficient vehicles that can use a variety of fuels. Only then can we stop exporting more than $1 billion dollars out of this country each and every week and use it here at home to strengthen our economy. Part of that solution is to encourage more efficient production of oil here at

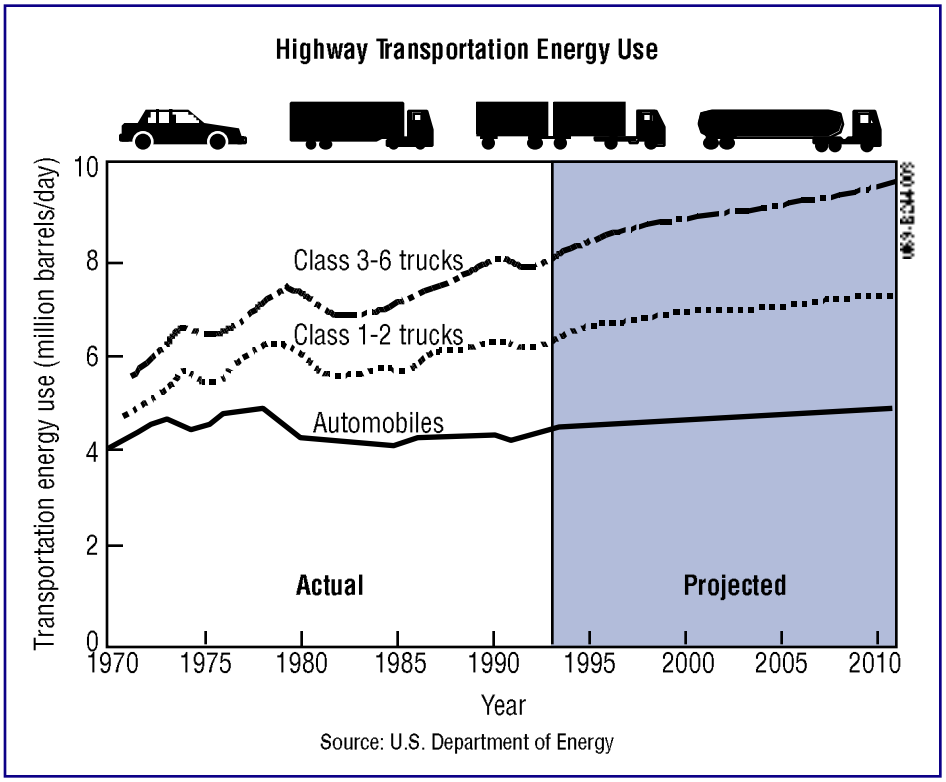


Source: *Annual Energy Outlook*, 1995, and *Monthly Energy Review*, August 1995, DOE Energy Information Administration

home and from more reliable sources around the world—both strategies are being pursued by the Clinton Administration.

What about air pollution? One of the greatest rediscoveries this past two years is that the American public demands a clean environment. In unambiguous numbers they have said that compromises on clean air and water are unacceptable. Here again, natural gas and other clean fuels play a vital role. The greatest remaining source of air emissions in many urban cities today is not power plants or industrial sites . . . but cars, trucks, and buses. We are spending over $50 billion each year on health care related to air pollution—pollution and health care costs that could be reduced with a balanced clean transportation strategy.

I speak a lot about natural gas and other alternative fuels. Why? Because only recently each fuel advocacy group would come into my office complaining about the preferential treatment elsewhere. After a while I couldn't figure out whether or not we were held captive by the electrics, the ethanol groups, or the natural gas lobbies. It was clear that the alternative fuels industries werecompeting against each other for less than half of the market. That kind of competition doesn't make much sense. So, I'm very glad to see a new sense of strategic cooperation across the groups. There's plenty of room for everyone at the fuel pump.



Of course we're all too familiar with the classic chicken and egg dilemma we face: how to simultaneously strengthen supply and demand. Part of the federal role is to at least get the chicken and egg in the same basket. Which is why the framers of the Energy Policy Act required us to promulgate regulations for state government fleets and for fuel providers. As you know, those rules published in March setting fleet requirements are effective for model year 1997.

Look how far we've come in just the past few years.

Ten years ago there were no directories for alternative fuel refueling stations. Today, there are a thousand-plus compressed natural gas refueling stations alone that could be listed.

In 1992, there were NO formal partnerships among the different levels of governments, fuel providers, fleet agencies, and other interest groups to promote alternative fuels in their community. Today, 48 U.S. communities have joined our Clean Cities Program already, and the list is growing. It is a program which recognizes the vital importance of the private sector and the market and which uses government as a consumer and a catalyst rather than a regulator.

In addition to laying the groundwork for Clean Corridors across the country, we will be creating export opportunities for our domestic equipment manufactures by creating links across borders and throughout the Western Hemisphere to cities who badly need the state-of-the-art technology that is produced right here in the United States.

In 1992, there was no official program to train and certify mechanics for alternative fuel vehicles. Today, industry supports the Department's training and certification efforts at dozens of technical colleges across the country . . . in collaboration with EPA.

Our research partnerships are producing the next generation of advanced natural gas vehicles that have a range of 300 miles per tank and are ultra low on emissions.

Sometimes I think we lose track of the simple logic needed to stay on track. In closing, let’s just remind ourselves of the basic questions we need to repeat over and over:

Do we need to reduce our dependency on foreign oil? Yes

Do we need to protect our air quality and health? Yes

Is there a single magic bullet out there that will meet all these challenges? No

Do we need to invest prudently in a balanced clean energy strategy that addresses both supply and demand? Absolutely yes

When we align our actions with those basic premises we will have an American that's not only better off, but an America that is BETTER. Thank you.

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The aim of **Alternative Fuels in Trucking** is to inform fleet owners and operators, equipment suppliers, government officials, and other interested parties about important developments in the use of alternative fuels in heavy-duty trucks. Suggestions and comments are welcome and may be directed to the National Alternative Fuels Hotline at 800-423-1DOE. Views expressed by guest authors are their own, and not those of ATAF, DOE, or NREL.

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How to Reach Us

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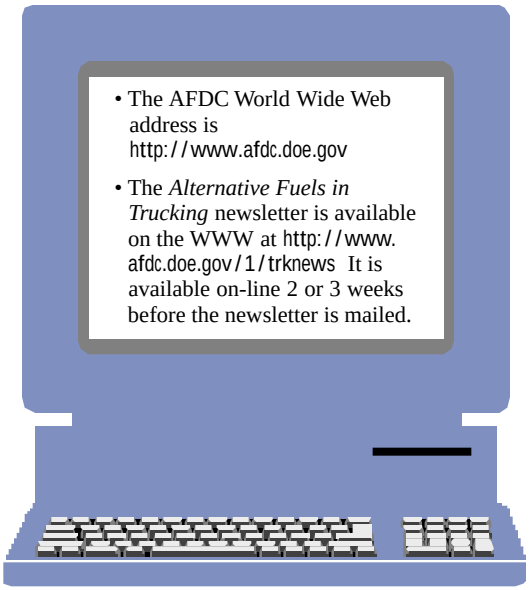

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